

# Guide to Drainage

## Background

Roads, tracks, landings and extraction tracks (snig tracks) can be significant contributors to sediment movement into watercourses, and must have working drainage to comply with the QPWS Code and environmental legislation..

In rainfall events, the drainage must work to remove surface water, avoid pooling of water, and to protect infrastructure.

## The QPWS Code

The Code of Practice for Native Forest Timber Production on Queensland's State Forest Estate 2020 (QPWS Code) is the core drainage management document in native forest operations in Queensland.



The QPWS Code refers to various operational schedules which are relevant to drainage.

**Schedule 9** - Forest, Road and Track Drainage (including extraction tracks) is commonly referenced throughout this guide.

The code identifies specific ways to ensure drainage is constructed and maintained appropriately. The design of drainage can depend on soil type, gradient and the region.

*All page references used throughout this document (e.g. pg 75) are for the **QPWS Code** - click to view online.*



## Acknowledgments

This field guide is a product of Timber Queensland's Native Forest Operations Capacity Building Project, funded by the Queensland Department of Agriculture and Fisheries.

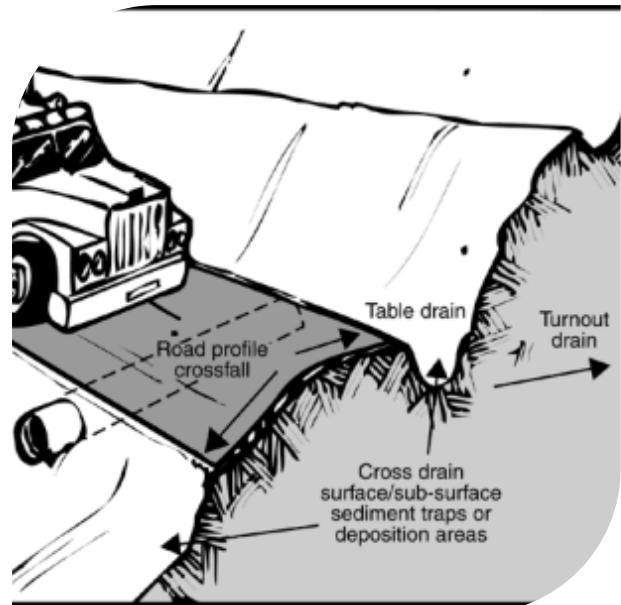
## Disclaimer

Information provided in this document is for general guidance only, it does not replace Codes, Commonwealth and State Government legislation. This field guide has been developed for Queensland state forests, however, some of the information and controls may assist private native forestry operations in meeting legal obligations.

## Objectives

The objectives of drainage are to ensure:

- Surface water is removed
- Flooding, seepage and ponding are avoided
- Infrastructure stability and durability is maintained
- Safe access for machines, trucks, and light vehicles
- Disturbance of soil movement to watercourses and exclusion zones is minimised.



Source: QPWS, 2020

## Critical Drainage Requirements

In accordance with the QPWS Code (The Code) critical drainage requires:

- Appropriate spacing and construction
- Drainage located in areas with significant changes in slope or direction
- Constructed at points of concentration of overland flow
- Constructed 10m before junctions with other roads, tracks and landings
- Adequate drainage for average rainfall events (1 in 5-year average)
- Drainage aimed at slowing velocity
- Suspending or filtering sediment before entering a watercourse
- Instating flat-bottomed profiles where soils are erodible
- Dispersing outflow onto stable ground or vegetation
- Not feeding drainage into water protection zones (Schedule 3)
- Carefully planning to avoid accelerated erosion

## Other Methods to Assist Drainage

- Use sediment traps or vegetate areas to slow down and deposit sediment
- Use materials including rock or gravel in drains to slow down velocity and prevent scouring
- Armour or line erodible areas with material, slash, timber, or rock
- Use flumes and other materials (debris) to divert and slow water
- Utilise natural drains and drainage
- Avoiding all forest operations in adverse weather conditions (wet or dry) that may impact the infrastructure



Sediment Trap

Source: HVP, 2022

## Other Drainage Considerations

- Routine maintenance of drainage is considered the 'minimum standard' within Operational Harvesting Plans (OHP)
- The OHP may have a 'Road Management Plan' and 'Drainage Standards' attached which must be implemented
- Having fit-for-purpose machinery to complete required drainage
- Existing unmaintained roads identified on the OHP with a lack of drainage may be used, providing drainage is installed to Code and decommissioned, unless otherwise specified in the OHP
- Consider road or infrastructure ownership before completing works

## Types of Drainage

### Cross Drains [pg 63]

- Allow surface or table drain water to pass across or under road pavement
- Can be used when natural drainage options are not available
- Outflows must be between 1-3 degrees with a maximum of 5 degrees.
- Types of cross drains include:
  - Inverts
  - Cross banks
  - Rollover cross banks and
  - Culverts

### Inverts [pg 64]

- Trafficable depressions in the infrastructure surface to divert water across
- Operators can dig material from the road to form the invert
- Material mat can be spread down on the surface downslope of the drain
- Inverts are suitable for lower grades/slopes
- Inverts typically have a v-shaped or flat-bottomed profile



Source: QPWS, 2020

### Cross Bank [pg 65]

- Banks constructed across the road surface to direct water across
- Typically non-trafficable
- Cross banks have a v-shaped or flat bottomed profile



Source: HVP, 2022

### Rollover Cross Bank [pg 65]

- Used where traffic is still required
- Still drivable for over 20kph
- Constructed by excavation or deposit of material to create a cross bank that still allows access



Source: Terrain, 2023

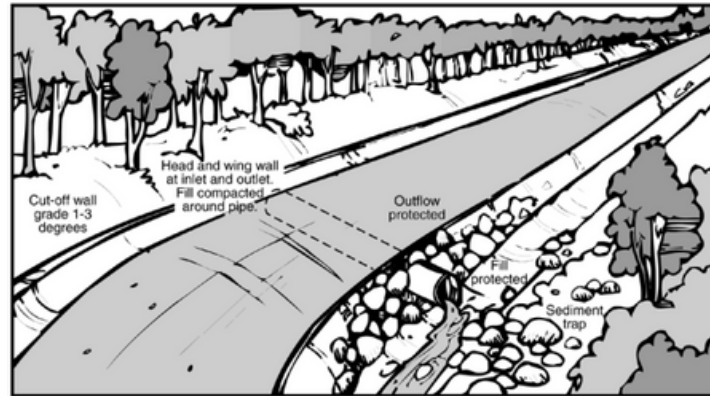
### Culverts [pg 63]

Culverts are pipe or box culvert structures that allow water to be channelled from under the infrastructure (commonly roads), from one side to the other.

Characteristics:

- Fall of 1-3 degrees
- Surrounded by compacted fill at both ends
- Have a cut-off wall to prevent erosion under the pipe
- Head and wing walls may be constructed with concrete, logs or rock
- Outflows must be provided with a scouring pad of vegetation, gravel, concrete, stone, or gabions

- If the culvert flows over onto the fill, adequate protection is required, including a flume or other methods to ensure the water doesn't erode the fill
- Culverts may have sediment traps, including logs or rock to trap and slow water and debris



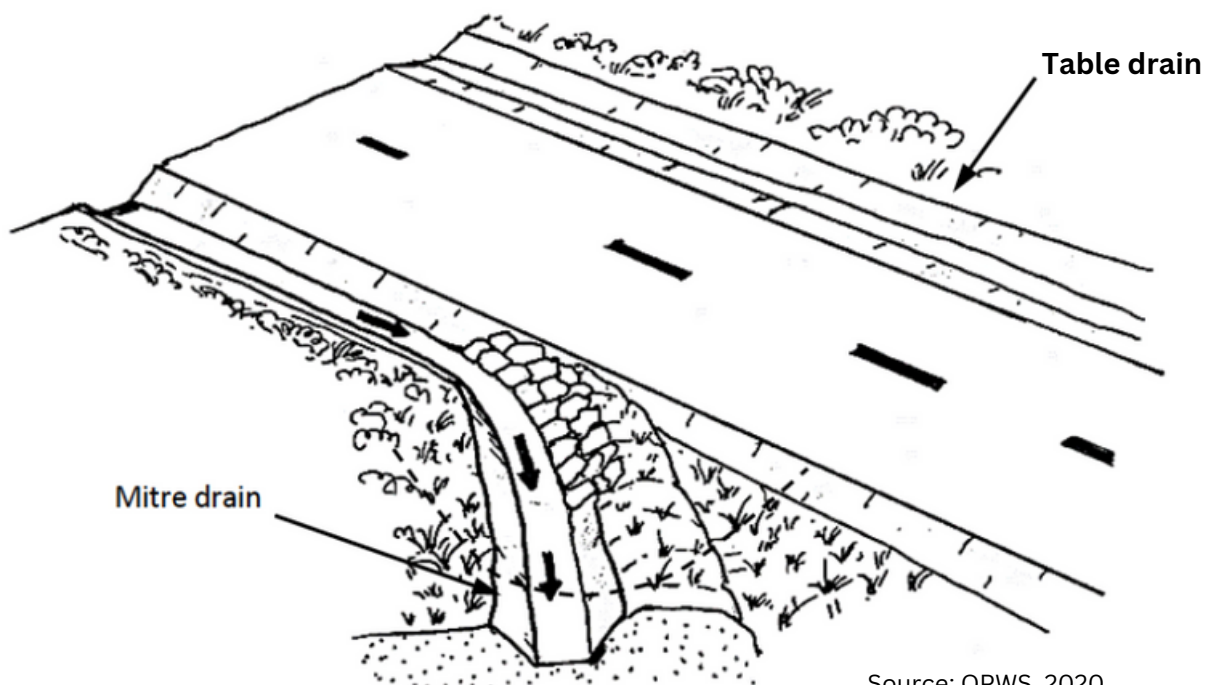
Source: QPWS, 2020

### Table Drains [pg 61]

- Protect infrastructure by diverting water away
- Have a v-shaped or flat-bottomed profiles
- Keep the road drier by keeping water away
- Fall of 1-3 degrees
- Diverted onto stable ground or surrounding vegetation
- Avoid diverting water onto watercourses and excluded areas

### Turnout Drains [pg 63]

- Divert water from table drains
- In the absence of natural drainage, are installed and spaced by The Code
- Outflows must be between 1-3 degrees with a maximum of 5 degrees
- Have a v-shaped or flat-bottomed profile
- Can be referred to as 'mitre drains'



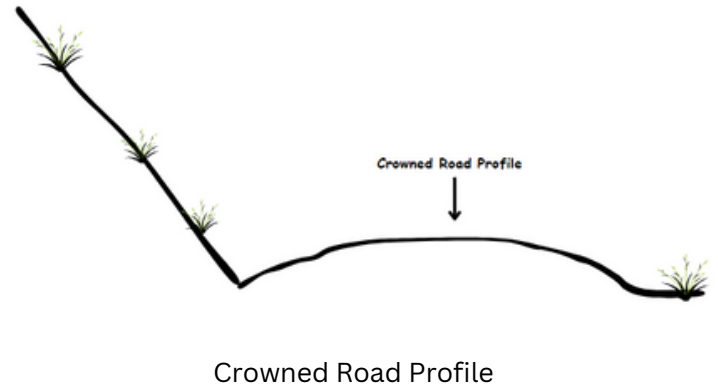
Source: QPWS, 2020

## Road Profile [pg 61]

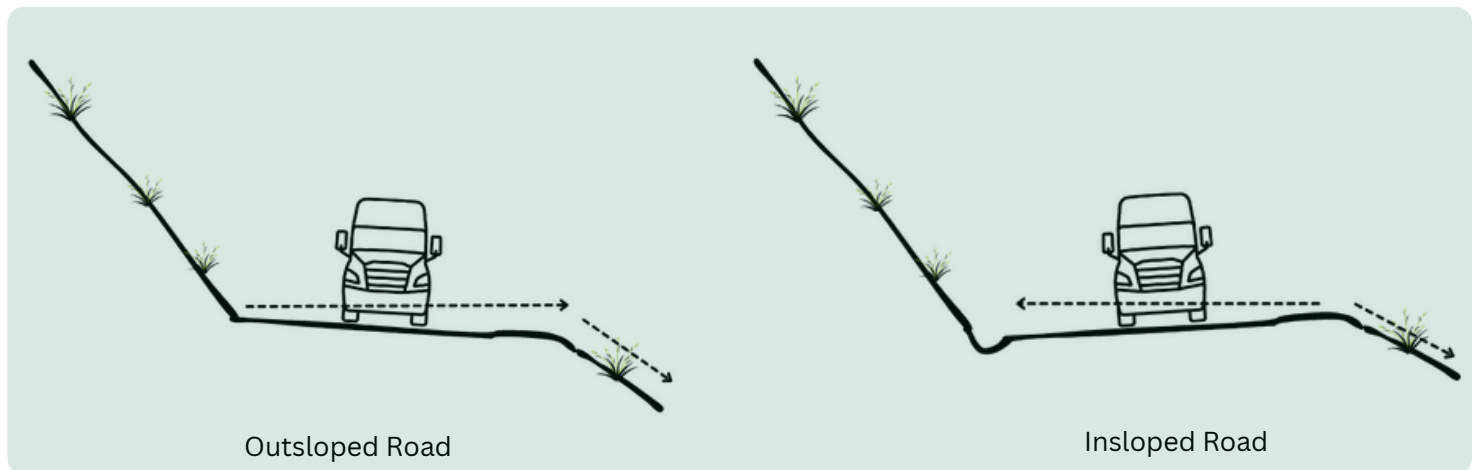
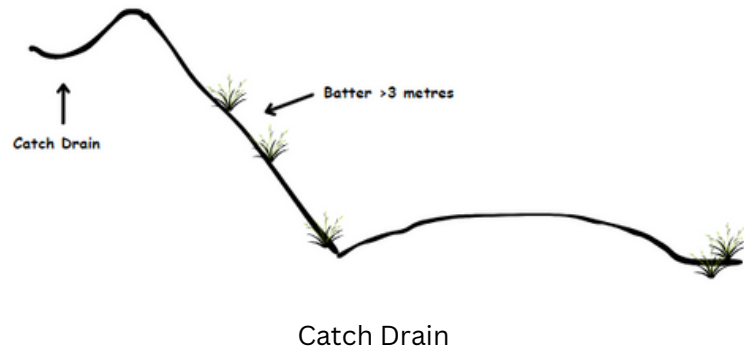
- Road pavements are shaped to shed surface water off the infrastructure
- Can include crowned, out sloped and sloped drainage
- The target cross fall for out sloped and sloped grade is 1-3 degrees
- Use natural drainage on flat-bladed tracks where possible
- Berms along the edge of the track should be breached at the set spacing intervals to allow water to drainage from the infrastructure
- Where suitable runoff drainage is not available, aim to apply other methods

## Catch Drains/Diversion Banks [pg 61]

- Required when side-cut batters are greater than 3m
- Catch drains are placed above cut batters to divert overland flow away from the side cut face and road.



## Utilise Natural Drains



Rock Armouring

## Water Bars [pg 66]

- Steep cross banks are used on roads that do not need to be trafficable
- Utilised to stabilise surfaces following harvest and haulage
- Water bar angles comply with The Code
- Only use when the track is no longer required
- Mounds are best compacted during construction by walking the machine over the consolidated water bar
- Mound height must be matched to the soil type and terrain
- Also referred to as Whoa Boys



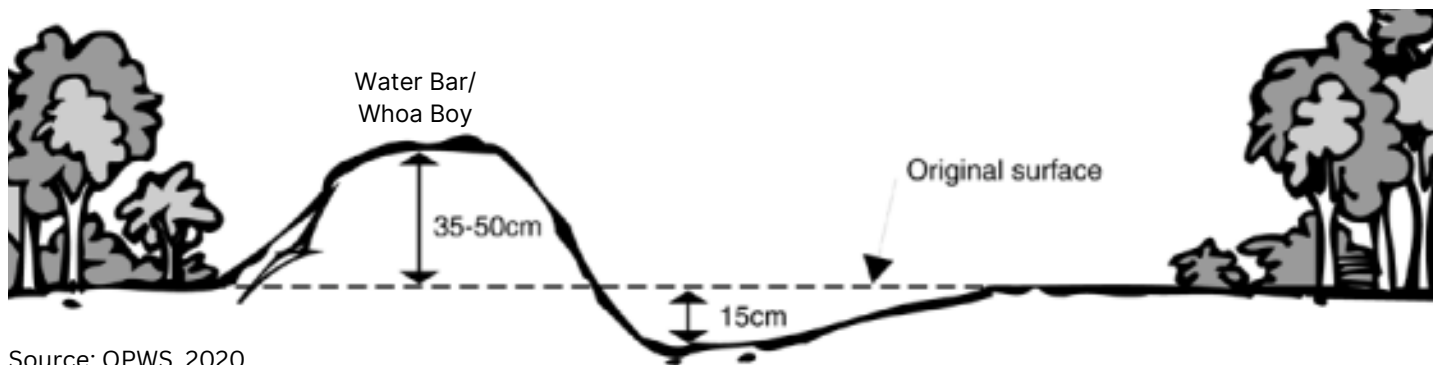
Water Bar Source: QPWS, 2020

## Small Mounds

- Less than 50cm high
- Used on soils that naturally pack well
- Consolidate well on low slope situations
- Assist natural drainage

## Larger Mounds

- Exceeding 50cm high
- Soil is loose
- Soil not formed well
- Slopes are steeper
- Water velocity likely to be higher



Source: QPWS, 2020

## Stabilising Washouts [pg 68]

- Determine the cause early
- Where major washouts cannot be fixed, use alternative infrastructure and access
- Line or install armoring at the inlets and outlets to prevent further erosions, collapsing, and scouring
- Advice from DAF may be required to manage extreme erosion and washouts

## Drainage Distance

Drainage needs to be a certain distance from Watercourse Protection Zones (pg 36):

- Road drainage - 20m
- Landing and snig drainage - 10m
- Distance before junctions - 10m

## Approach to Drainage

Use the following table to assist with classifying the spacing requirements.

The level of Code compliant drainage required is dependent upon an erosion risk rating. *The QPWS Code Schedule 20 - Soil Assessment* provides a process for estimating erosion risk.

Refer to the OHP to determine the erosion risk rating, alternatively apply a “high” risk rating for drainage frequency in your harvest region.

## Note:

- Cross drain angle only applies to water bars on high erodibility soils
- Regions:
  - C = Coastal
  - SC = Sub - Coastal
  - W = Western
- Regions can be found within the Operational Harvesting Plan

## Example:

For a 6-degree track grade in the Western region, a drain is required every 40m.

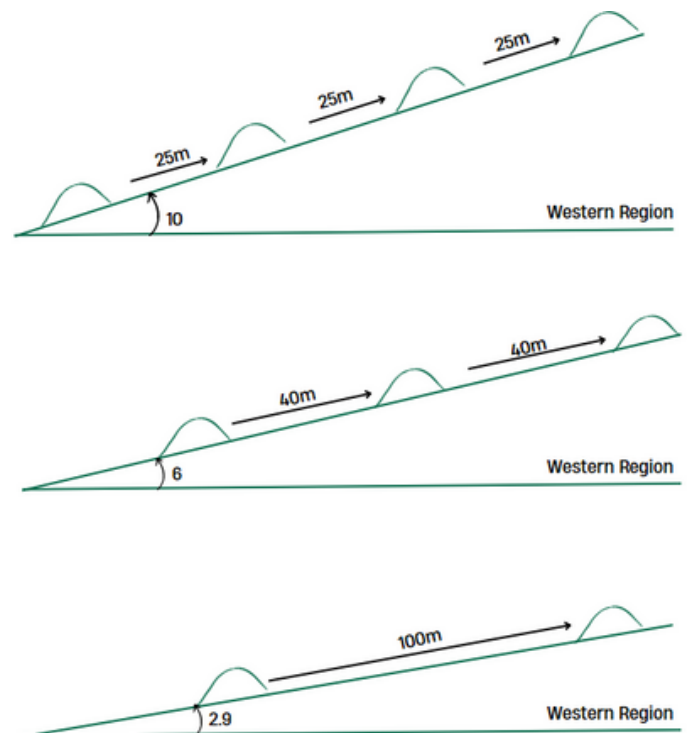
When Whoa boys are installed on tracks in this situation they should be offset at 20 degrees

## Separation distances for turn-out drainage

Grade Degrees	Water bar offset angle <sup>(3)</sup> Degrees	Soil erodibility rating <sup>(4)</sup> by regions <sup>(5)</sup>								
		Low			Moderate			High		
		C	SC	W	C	SC	W	C	SC	W
<3	Up to 30	150	175	200	110	145	175	60	70	100
3-5.9	Up to 30	110	140	160	70	100	120	40	50	60
6-7.9	Up to 20	80	100	120	50	65	75	30	35	40
8-10.9	Up to 20	50	60	75	35	40	50	20	20	25
11-14.9	Up to 10	30	35	40	20	25	30	15	20	20
15+	Up to 5	20	20	20	15	15	15	15	15	15



Cross Drain Source: HVP, 2022



## Other Key Elements of Drainage

### Stabilising and Deactivation

Stabilise and deactivate roads, tracks, landings, and extraction tracks to avoid soil erosion, impact on water quality and to protect the infrastructure.

Aim to:

- Progressively stabilise all drainage (pg 75)
- Only use water bars where the infrastructure (eg. road and track) is no longer required (pg 66)
- Stabilise landings after 2 weeks and when rainfall is forecast (pg 74)
- Decommission or temporarily close roads and tracks after use (pg 57)
- Temporarily stabilise haulage roads during the operation or when high rainfall is expected (pg 75)
- Ensure haulage roads restored within 2 weeks of completion (pg 75)
- Any damage to road surface or drainage must be repaired within 2 weeks (OHP)



Example of an extraction track with machine rutting and no drainage.

### Remember:

**Document your decisions,  
refer to the QPWS Code and  
if you are unsure, always ASK!**

### Non State-Owned Land

For all drainage on non state-owned infrastructure, permission must be sought.

Make contact with DAF to determine the process to complete drainage construction or maintenance on non state-owned land.

### Inspections and Audits

DAF and QPWS undertake frequent inspections and audits. The following topics may be audited during forest operations, in line with the Code:

- Appropriate drainage construction
  - Adequate erosion and sediment controls
  - Inadequate or excessive drainage
  - Appropriate drainage into watercourses
  - Road and track management
  - Repair infrastructure
  - In appropriate locations
- Ensure harvest debris is removed from road surfaces, culverts and drains
- Adhere to WPZ and exclusion zones and
- Others

### Documentation

- Seek approvals are in writing
- Retain approvals records
- Report decision making processes
- Seek permission and document for drainage on non state-owned infrastructure